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Revision 0

Decommissioning The 216-Z-9 Crib Plutonium Mining Facility At The Plutonium Finishing Plant: Issues Characterization

Prepared for the U.S. Department of Energy
Assistant Secretary for Environmental Management

Project Hanford Management Contractor for the
U.S. Department of Energy under Contract DE-AC06-96RL13200

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INTRODUCTION

The 216-Z-9 Recuplex CAW (CA column waste) Waste Disposal Cavern, also known as the Z-9 Trench or the Z-9 Crib, is located near the Plutonium Finishing Plant (PFP) facility at the Hanford Site in Eastern Washington State. The 216-Z-9 Crib was used as a disposal site for effluent chemical and radiological wastes from the recovery of uranium and plutonium through extraction or RECUPLEX process, a method that recovered uranium and plutonium from liquid and solid wastes and scraps from other PFP process.

The Z-9 Crib was constructed as an engineered trench with an open area resembling a cavern or cave beneath a concrete slab. It is 6.4m (21-ft) deep with a 23cm (9-in) thick concrete slab measuring 27.4m by 36.6m (90-ft x 120 ft), Figure 1. The Z-9 Crib received liquid wastes from 1955 through 1962, which amounted to approximately one million gallons (4×10^6 L) of liquid wastes during its operating life. Analyses of the crib soil in seven locations to a depth of up to six feet (two meters) beneath the crib floor indicated that the plutonium content of the crib soil ranged from 50 to 150 kg (the highest concentration measured was 34.5 g/L of soil). The history of the 216-Z-9 Crib as of November 1971 has been documented by Crawley, including information regarding deposition of plutonium, sampling and analysis, and hazards evaluations of the crib soil. [1]

In 1973, a decision was made to remove the top 30 cm of contaminated soil as a means of reducing the risk of a criticality incident. The soil at the bottom of the crib was removed using a clamshell digger and conveyer bucket system. A hydraulically-operated clamshell was suspended from a trolley assembly that traveled along a horizontal boom. The clamshell lifted soil from the trench floor and deposited the soil into the soil bucket that resided on an inclined elevator carriage. The conveyer extended from the trench floor through the trench roof into the glovebox located in the packaging building.[2]

Prior to the initiation of excavation or mining activities, the 216-Z-9A, the Contaminated Soil Removal Building, the 216- Z-9B, Operator's Cubicle, and the 216-Z-9C, Mining Apparatus Enclosure were constructed next to and on top of the crib cover. Mining equipment was installed beneath the crib cover and suspended on structural supports in order to remove soil and package it in cans for plutonium recovery or disposal, depending on the concentration of plutonium in the retrieved soil. Mining of the enclosed Z-9 Crib trench was completed in 1978 with the removal of approximately 58 kg of plutonium. The 216-Z-9 Facilities were placed in layup status at the completion of the mining activities.

WORK DESCRIPTION:

Deactivation and Decommissioning (D&D) planning and characterization work has begun on the crib buildings and mining structures. In order to accomplish the D&D however, analyses of the structural integrity of the crib cover, the shut-down ventilation system, combustible gases and other chemical and radiological constituents of the crib atmosphere and potential air emissions are required.

Technical issues identified prior to conducting building removal include structural stability of the crib cover and mining apparatus and combustible/toxic gases within the crib area. Based on existing knowledge of the facility and site, concerns over the structural integrity of the crib slab, which provides support for the mining structures and equipment and also containment for preventing airborne release of contamination, are significant. For example, recent video taping and high

resolution photography of the underside of the concrete crib cover has shown that many protective tiles have fallen from the cover indicating areas of the undersurface are unprotected from the acidic environment of the crib atmosphere. Photographic characterization of the underside of the crib cover is on-going.

Additional issues to be resolved are associated with preventing radiological contamination and personnel exposure of site workers during the D&D. These concerns are related to the safety of personnel working on the cover slab or making entry into the trench, as well as the long-term integrity of the concrete cover for 20 years following building removal. A major source of concern is that hydrochloric acid (HCl) generated from the degradation of carbon tetrachloride has and could continue to degrade the integrity of the undersurface of the concrete cover and /or support columns. Structural issues also include the

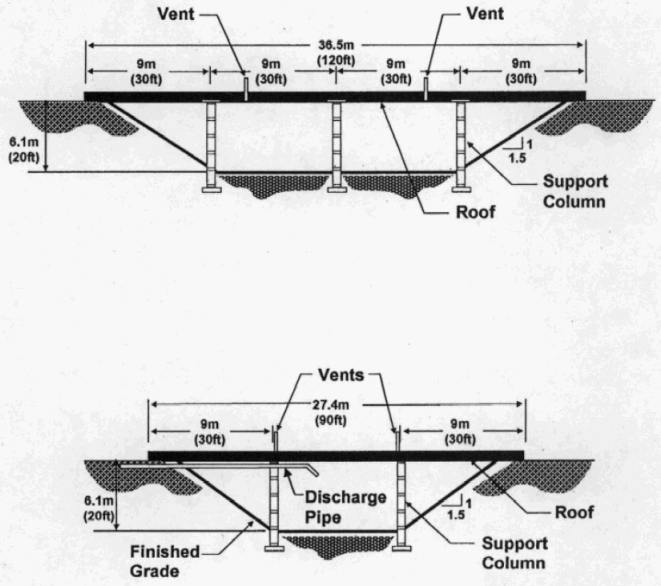

Figure 1. As-built section views of the 216- Z-9 Crib

integrity of the buildings relative to safe demolition practices, continued integrity of the hanger rods to maintain building support loads, and continued integrity of the tile placement that provides protection to the concrete slab and columns.

Wendel, in the layaway plan for the mining facilities, listed criteria for layaway of the facilities that discusses prevention of overloading the crib slab, prevention of the accumulation of flammable gases and decontamination of all equipment.[3]

This paper provides the approach proposed in gathering the required data to safely perform the D&D activities for the Z-9 Crib buildings and mining structures, and preliminary photographic data.

DESCRIPTION OF THE ACTUAL WORK

In order to decommission the crib mining structure and the equipment attached to the Z-9 Crib, an analysis of four issues must be accomplished. These issues are:

1. Determine the structural integrity of the crib trench slab for bearing live loads during D&D and also for serving as a containment barrier to control potential alpha airborne emissions for 20 years,
2. Determine the nature of the gases generated from radiolytic hydrolysis of water and organics accumulating in the trench area under the cover slab for potential flammable concentrations of gases,
3. Determine the use and condition of the electrical equipment and the ventilation system during the D&D effort, and
4. Collect the radiological data for additional nuclear safety analyses needed for the D&D work in the glovebox to proceed.

To define the data needs associated with determining the structural integrity of the crib cover, a data quality objectives process was performed. The resulting data needs that were identified included comprehensive, high resolution photography of the crib cover underside and visual structural inspection of the buildings and crib cover surface. These data will provide information for complete structural analysis by an expert engineering team.

A structural inspection and cleanup of the 216-Z-9B, Operator Cubicle which provides a view into the crib area, was completed. Routine access by engineers is now allowed.

A manned entry into the crib area was considered by the project management team as a way to obtain the required data. Due to ALARA concerns as well as concerns regarding chemical vapors and structural obstructions, manned entry at this time will be avoided. Instead, the team acquired a robotic crawler fitted with high intensity lighting, and a high resolution camera was constructed to provide the photographic data for the inspection.

The robotic crawler was deployed and preliminary photographs were taken as shown in Figures 2 and 3.

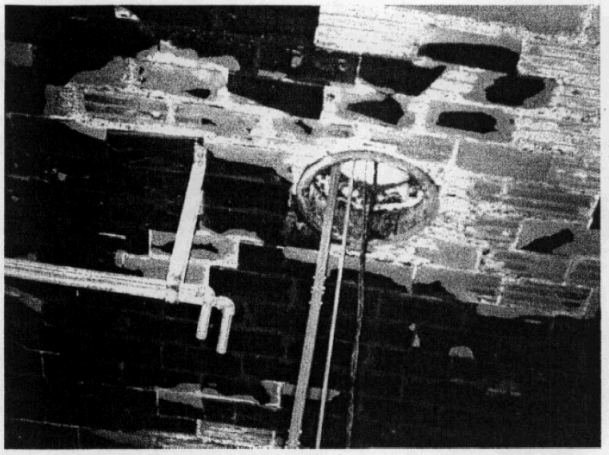

Figure 2. A view of the underside of the 216-Z-9 Crib concrete cover showing missing and broken protective tiles and the chemical discharge pipes.

Figure 3. Bottom and side view of Operators Cubicle showing viewing window.

RESULTS/LESSONS LEARNED

Initial high resolution photography has shown that the condition of the crib cover is compromised by the absence of protective tiles in large areas of the concrete. The supporting columns appear to be in good condition. The surface of the soil is littered with broken tiles and concrete material.

The compromised roof and condition of the floor of the crib confirm that hazards exist for manned entry. Initial air sampling and analysis results show very low levels of flammable and toxic gases.

Deployment of robot crawler and cameras was accomplished efficiently and without incident. No radiological contamination was detected around the riser extension or the glove bag structure.

Important lessons learned in the project involved the use of a mockup and a dry run. A mockup of the crib riser was developed and a dry run of the equipment deployment was performed at a Hanford facility. As a result of this exercise, several important changes were made to the work evolution instructions. As a result, the deployment of the robot crawler and cameras went exactly as planned. Additionally, the preparation of a work plan including a quality assurance project plan was important in ensuring that the data gathering is comprehensive and meets the needs of the engineering team.[4]

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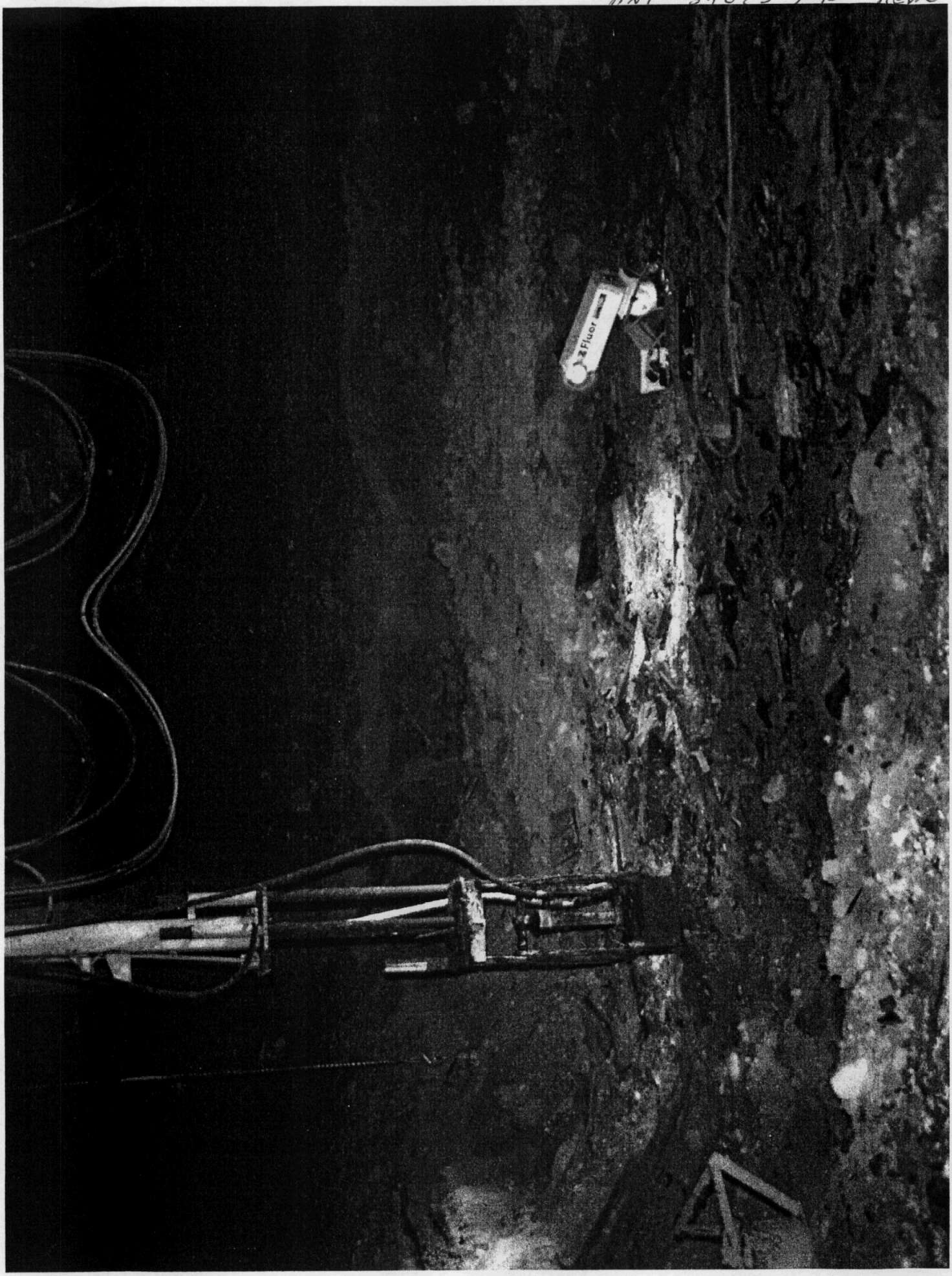
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